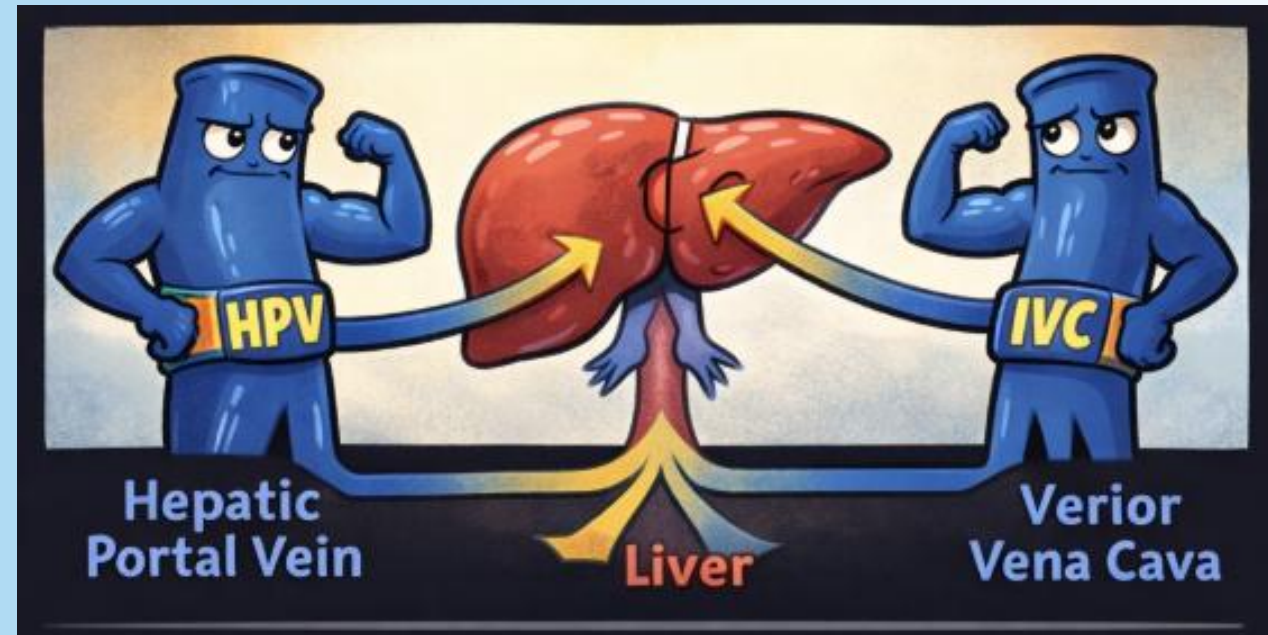


Venous capillary system, Hepatic portal system & Abdominal/pelvic lymphatics

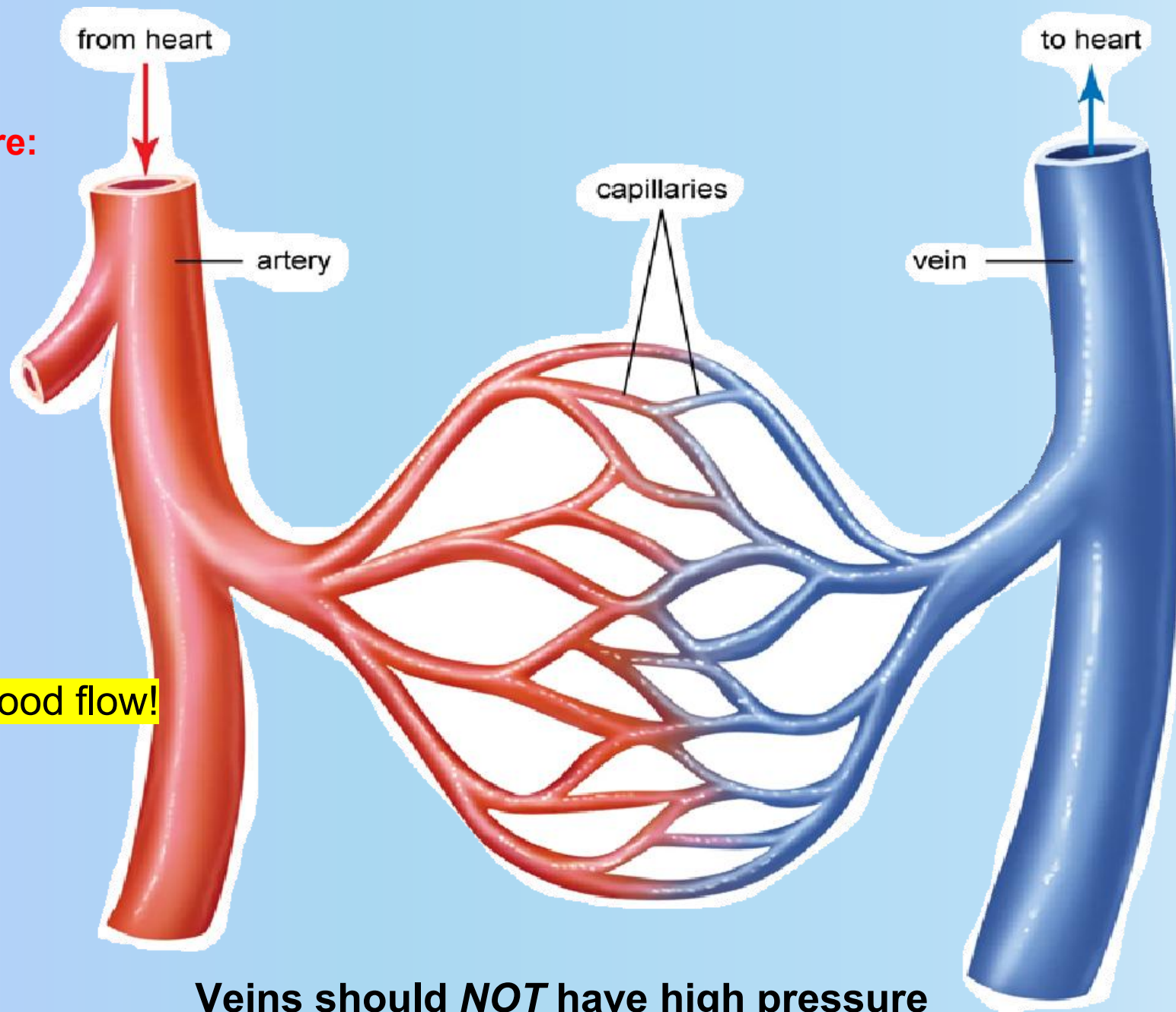
By Glenn André Breivik

Overview

- Introduction of veins
- Venous capillary system with **portosystemic anastomosis system**
- Hepatic portal system & caval system
- Lymphatic drainage abdomen/pelvis



Arterial pressure:
80-120 mmHg



Venous pressure:
4-8 mmHg

Artery + Vein:
High + Low = Good flow!

Vein + Vein:
Low + Low = Good flow!

Veins should NOT have high pressure

Why does a venous plexus exist?

Anastomoses of two or more veins make it possible to access an «escape route», and go «the wrong way».

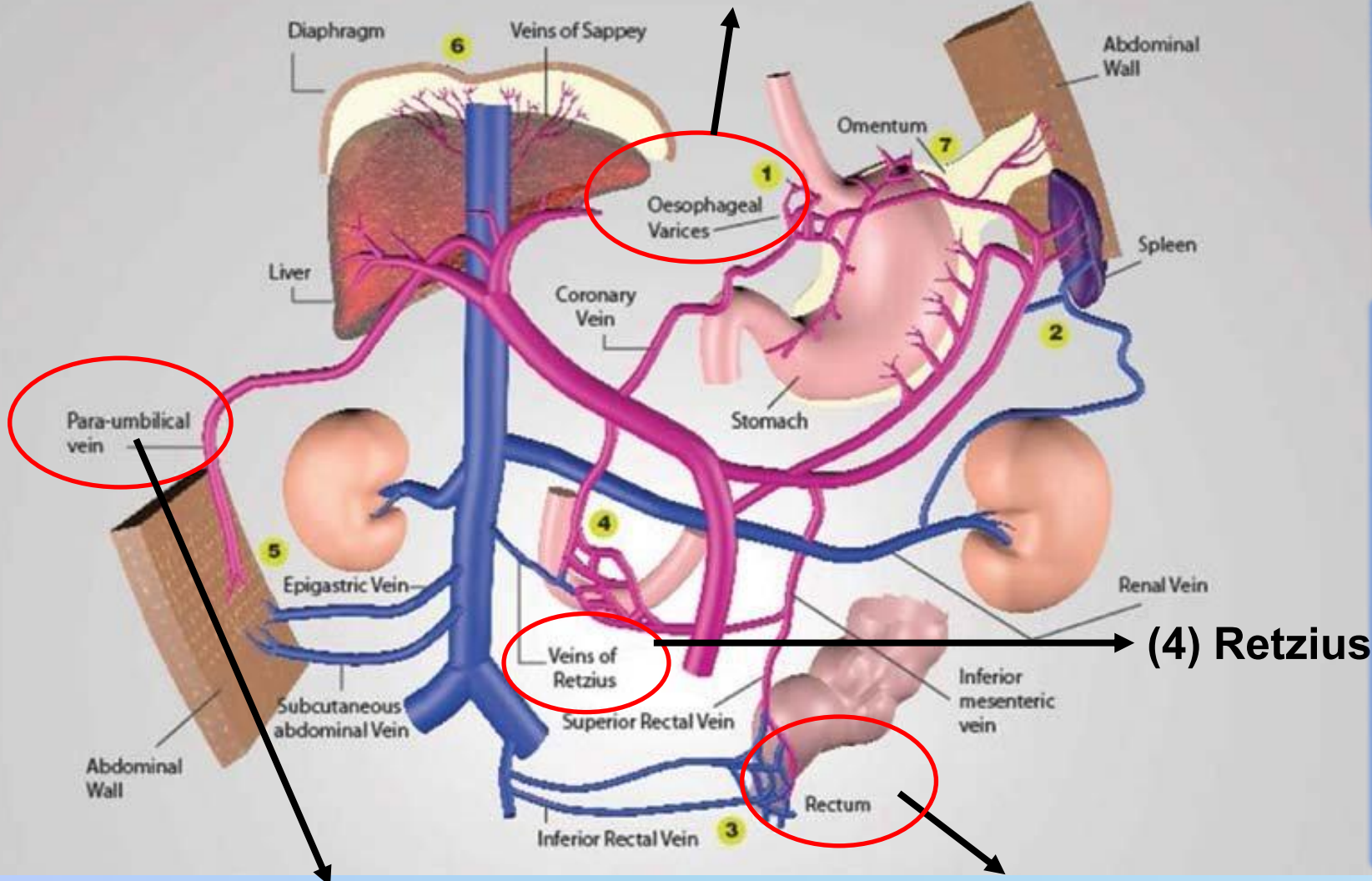
Sometimes, the same vein takes the blood flow in reverse.

This is in case the caval/hepatic portal system has some issues, like a blockage.

Venous anastomoses systems (portocaval system)

- Checkpoints

(3) Oesophageal venous plexus



(2) Umbilical venous plexus

(1) Rectal venous plexus

Prostatic/vesical venous plexus is not mentioned (8)

- Moore's Clinical Anatomy only mentions 4 of them:

1. Rectal
2. Umbilical
3. Oesophageal
4. Veins of Retzius & Retroperitoneal veins.
- (5). Intrahepatic portosystemic anastomoses)

Important rule:

In a venous plexus system:

- One vein to hepatic portal system
- One vein to caval (systemic) system

THESE ARE LINKED AND CAN WORK BOTH WAYS WHEN NEEDED

(often dominant one way)

This is a golden rule with few exceptions

Rectal venous plexus

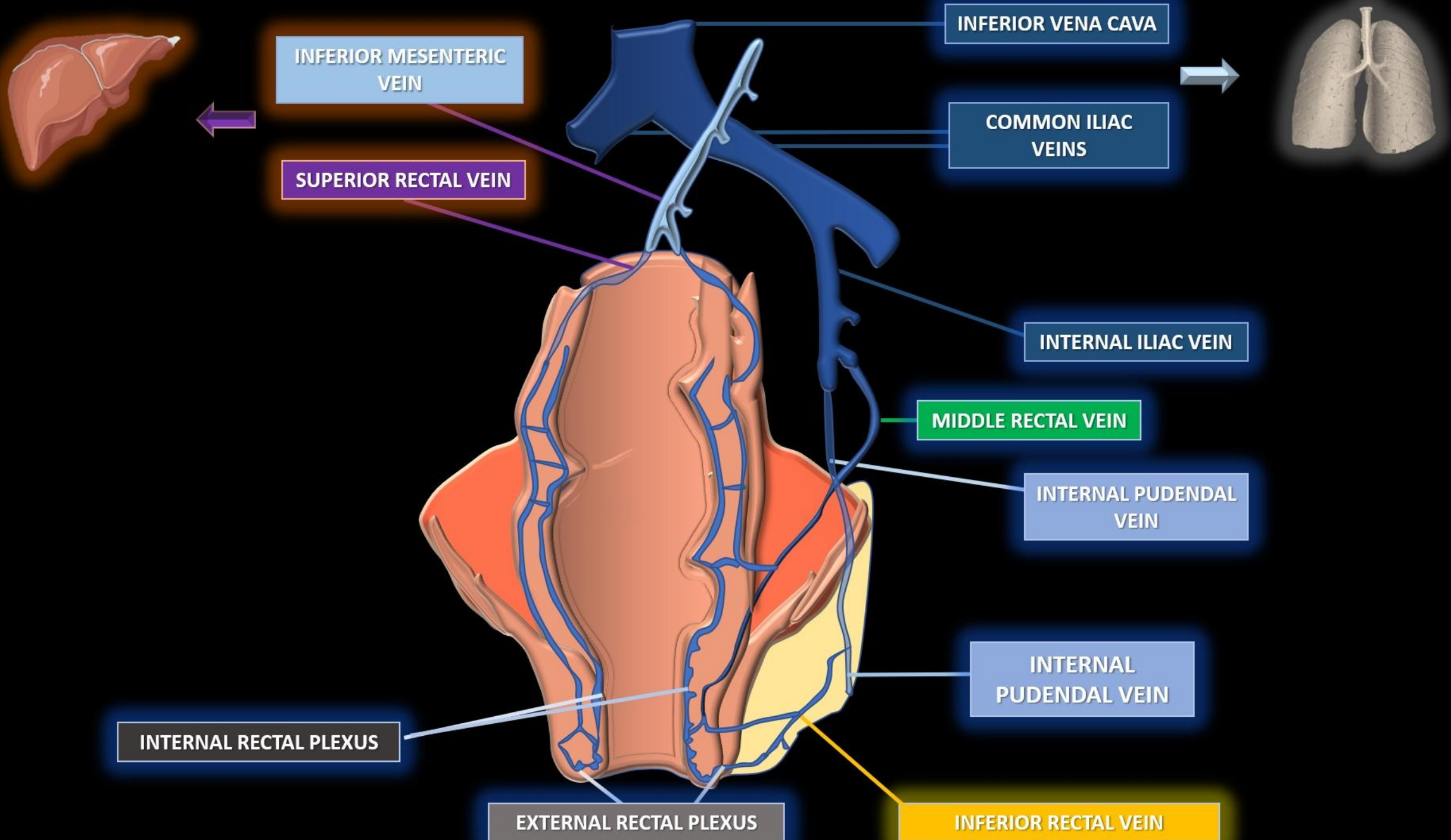
- *Superior rectal vein* → *Inferior mesenteric vein* (*hepatic portal system*)
- *Middle rectal vein* → *Internal iliac vein* (*caval system*)
- *Inferior rectal vein* → *Internal pudendal vein* → *Internal iliac vein* (*caval system*)

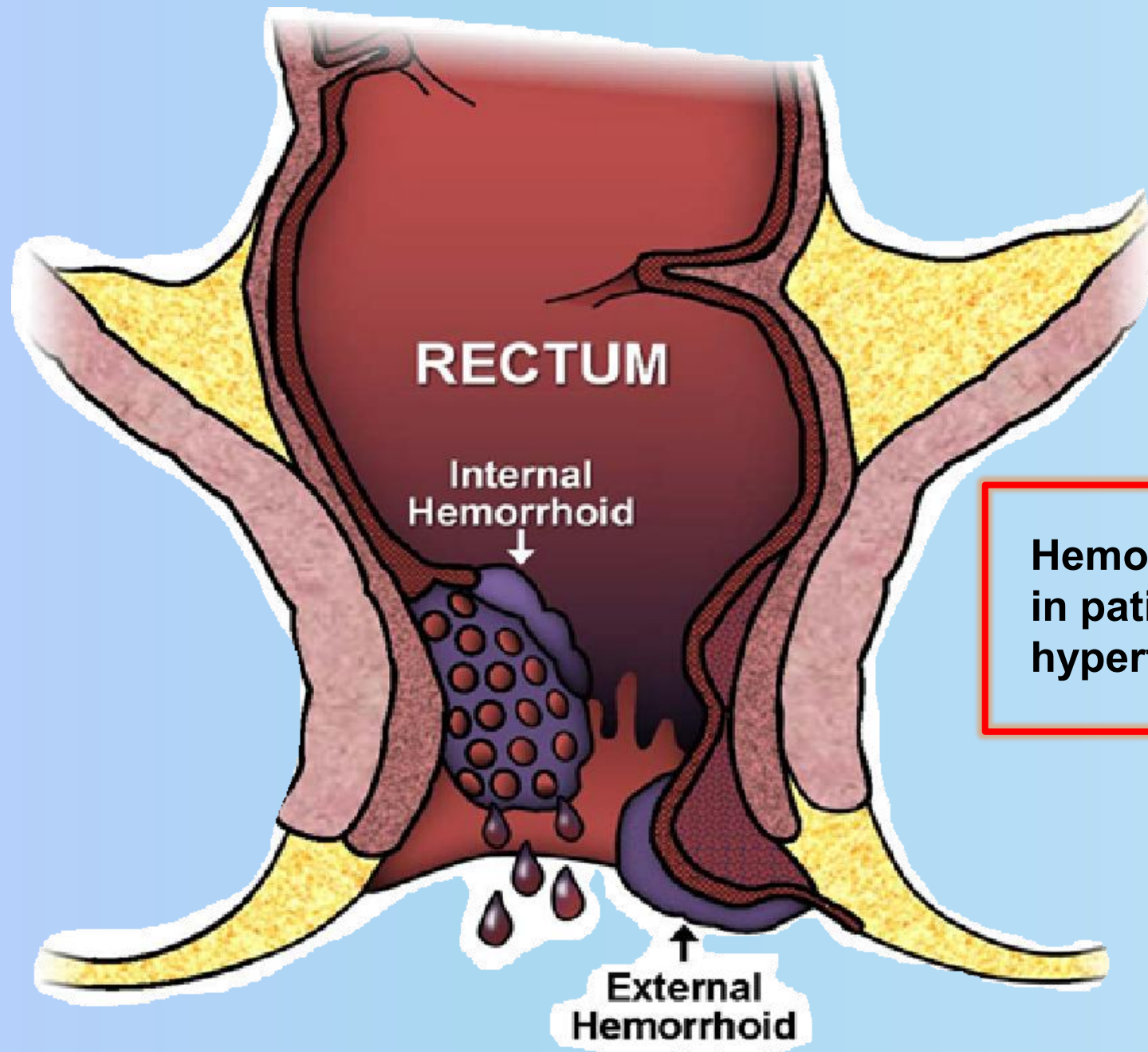
What is the point of this venous plexus?

The blood of the rectum can mix in this plexus, despite draining the specific parts.

This allows for an alternative route in case the caval/hepatic portal system has some issues, like a blockage.

Also – the rectum is a weirdly positioned organ!





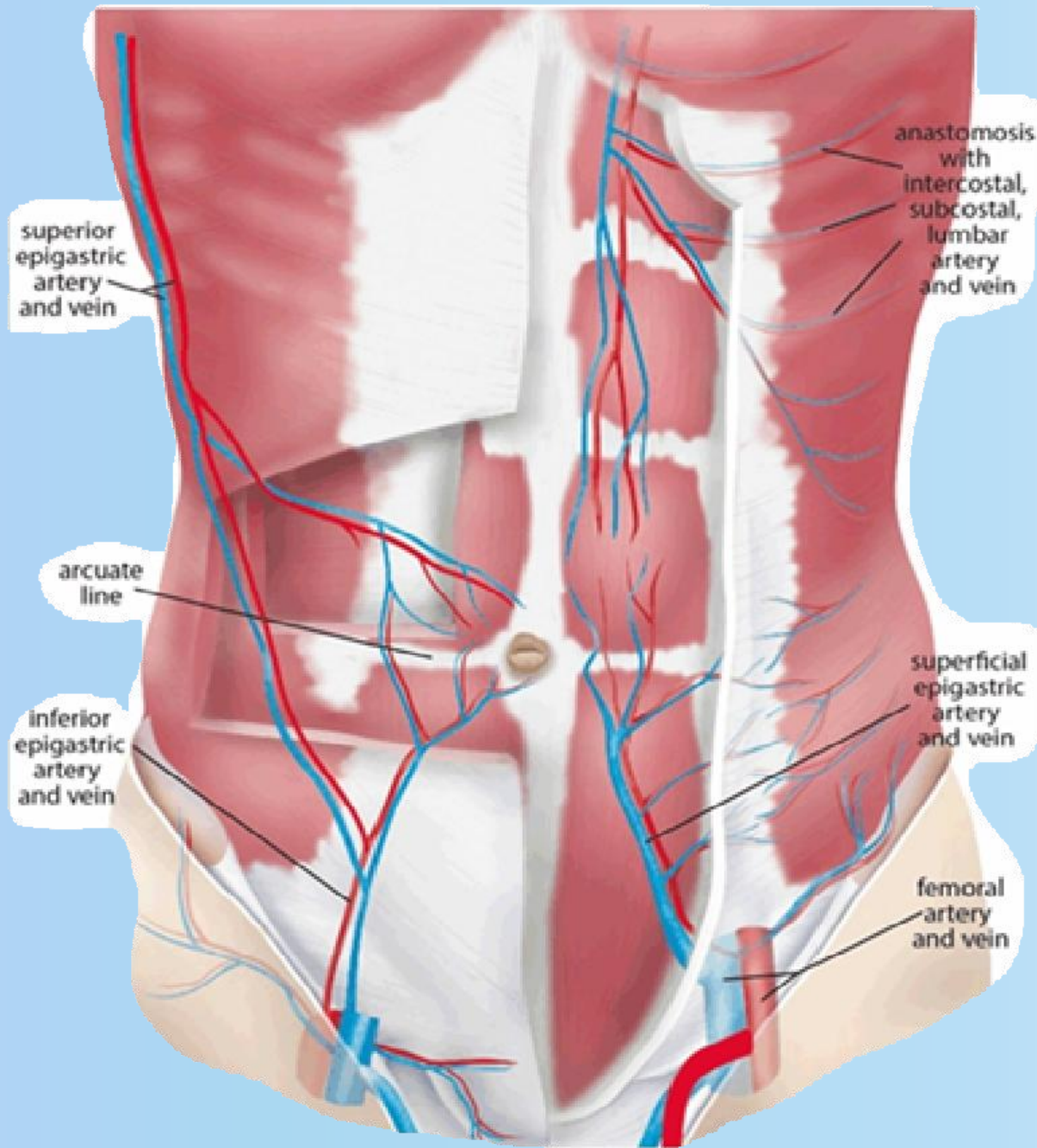
**Hemorrhoids will bleed heavier
in patients that have portal
hypertension**

Umbilical venous plexus

- Will drain the abdominal wall and the plexus is at the umbilicus.

Two relevant veins:

1. Paraumbilical vein → *(Hepatic portal system)* 
2. Epigastric veins (Superficial, superior and inferior) → *(caval system)*
 - Superior epigastric vein → Internal thoracic vein 
 - Inferior epigastric vein → External iliac vein 
 - Superficial epigastric vein → Great saphenous vein/femoral vein 





Caput medusae:

Due to increased
hepatic portal-
systemic pressure

Rule:

❖ Skin above umbilicus (bellybutton):

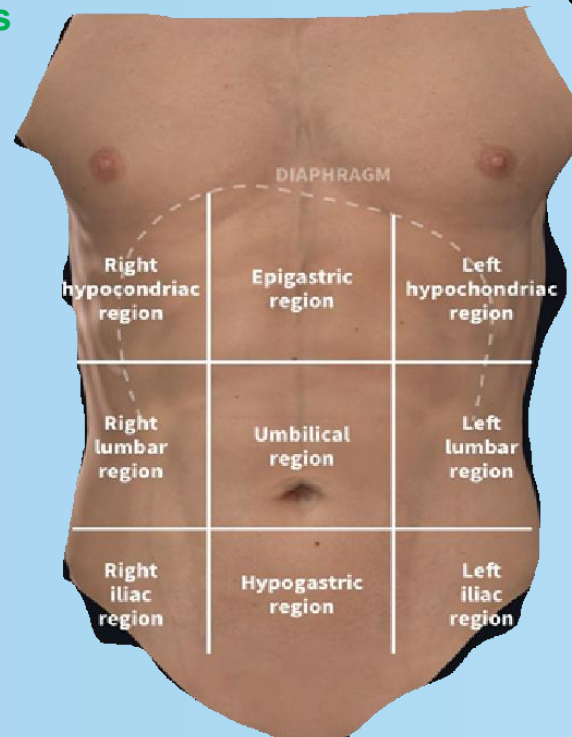
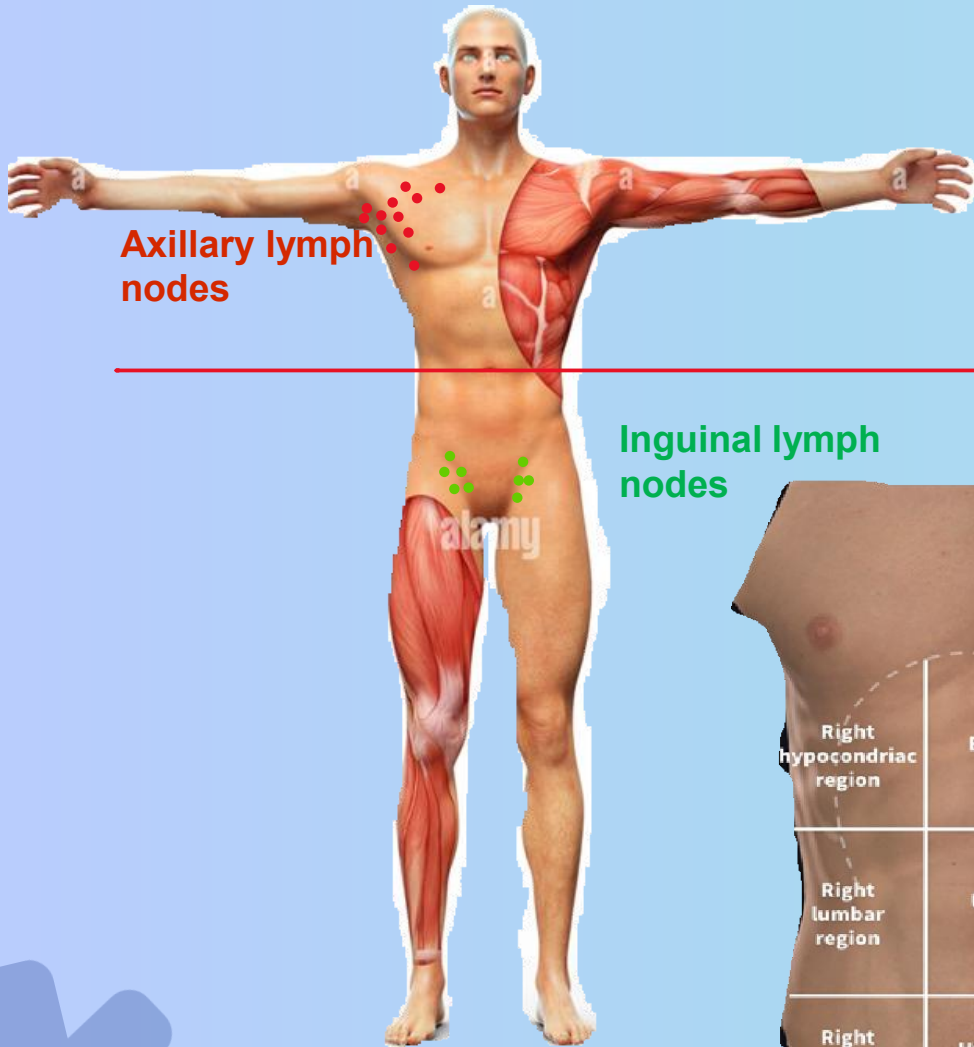
Drains into axillary lymph nodes

Axillary lymph
nodes

Inguinal lymph
nodes

❖ Skin below umbilicus (bellybutton):

Drains into superficial inguinal lymph nodes (in the hip)



Oesophageal venous plexus

(located at the lower 3rd of oesophagus)



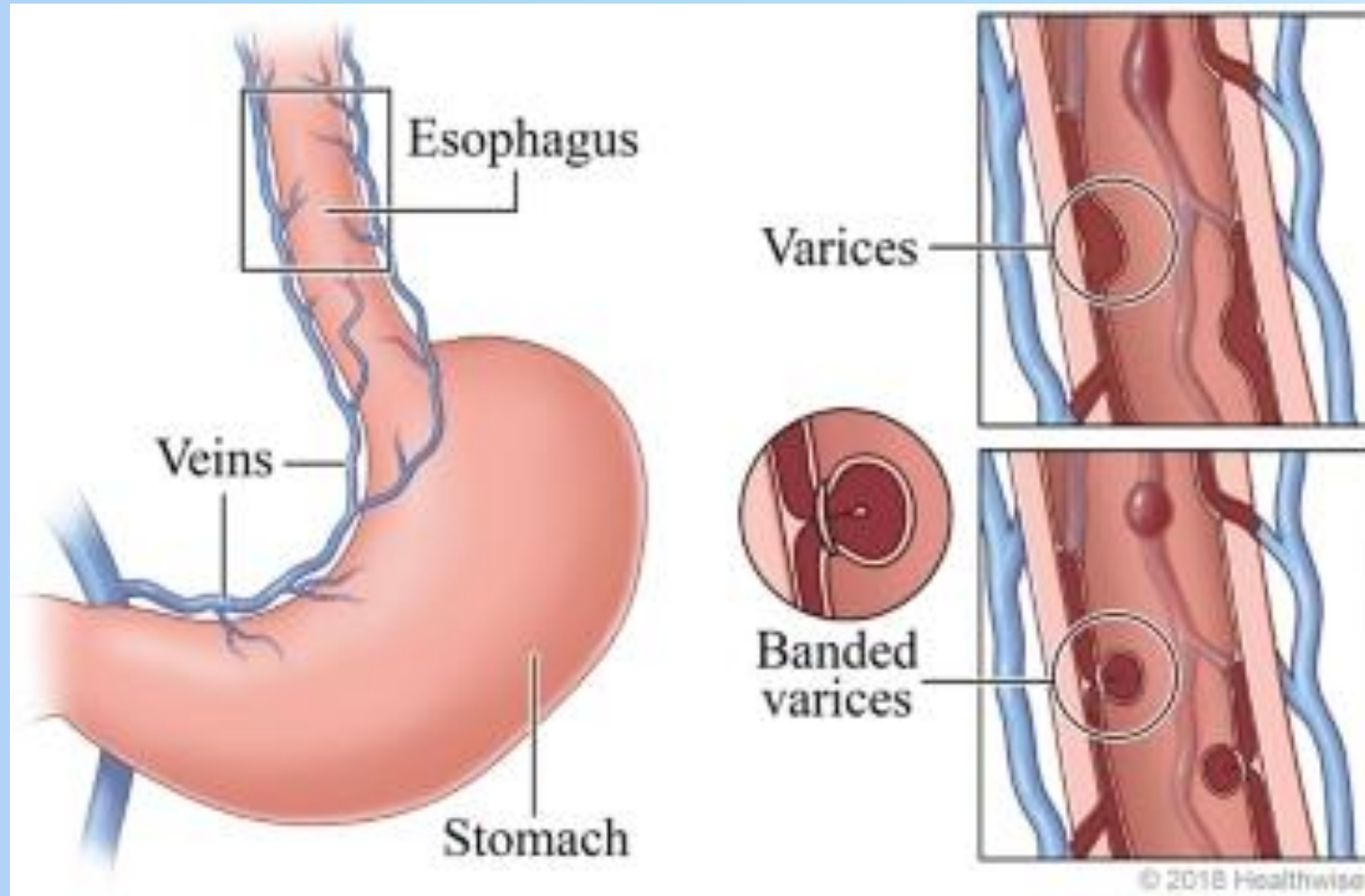
- Right gastric vein → (Hepatic portal system)
- Left gastric vein → **BOTH** (Hepatic portal system) and (caval system through the Azygos vein).
- Can cause oesophageal varices which is extremely dangerous! Treatment?

Avoid oesophageal varices in the first place.



Ruptured oesophageal varices

(severe bleeding due to rupture of the veins - hard to save the patient when it happens)



Veins of Retzius & Retroperitoneal portocaval veins

These are less dominant veins, so they drain less than the main veins to the portal system

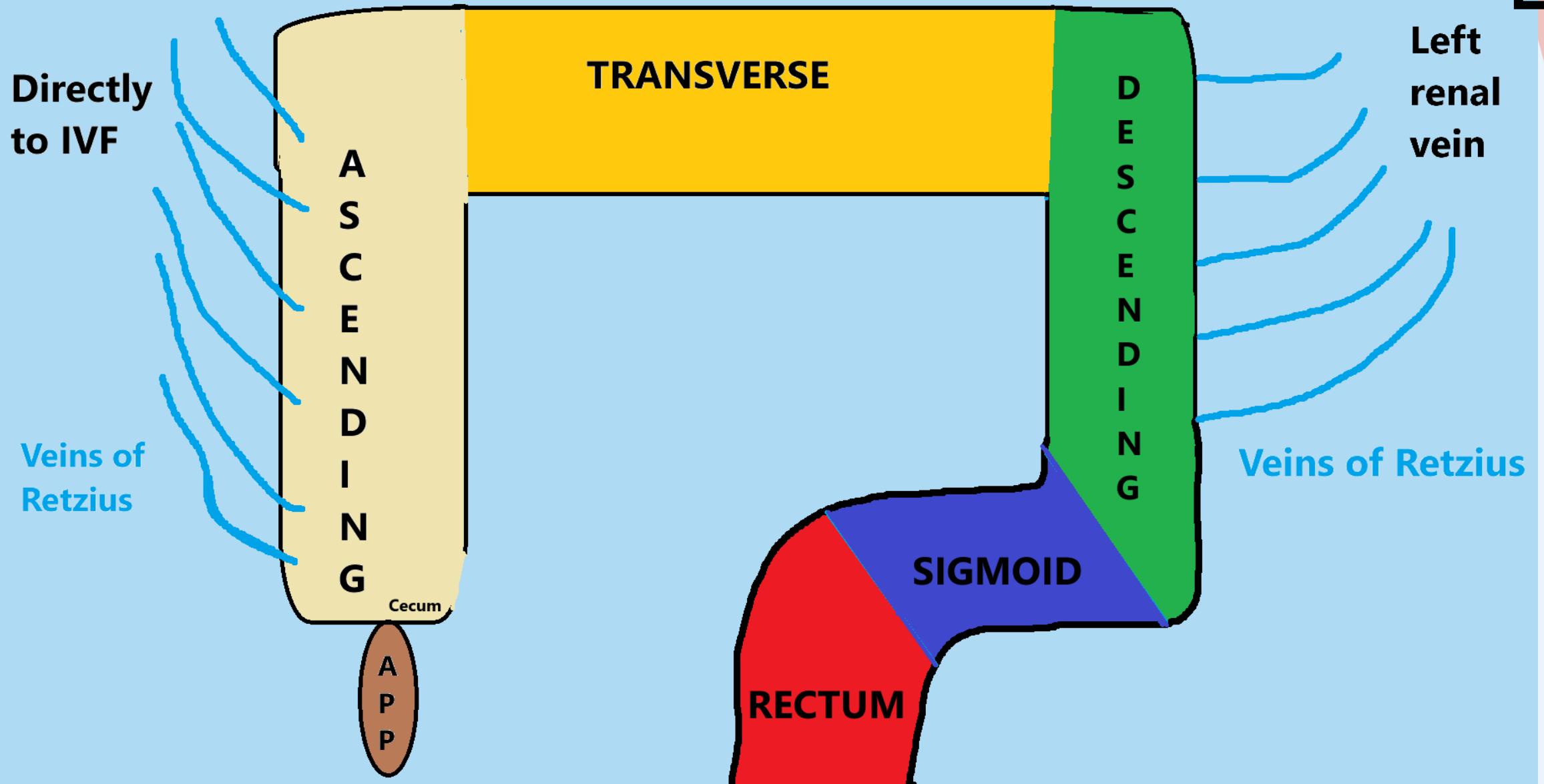
- Will drain into the **caval system**.
- They drain to the caval system because they drain the retroperitoneal organs that normally drain into the **hepatic portal system**:
 - Duodenum
 - Spleen
 - Head, neck and body of pancreas
 - **Ascending colon**
 - **Descending colon**

An example with veins of Retzius:

- **Ascending colon** → Directly to inferior vena cava
- **Descending colon** → Directly to the left renal vein → IVF

R

L



Right and left venous route is no coincidence!

My 2 statements:

- 1 The organs/structures that drain into the **hepatic portal system** can be considered «**dirty**». The blood from these organs needs to be cleaned by the liver to avoid spreading infections/dealing with toxic components, or they are in relation to other «dirty» organs.
- 2 The organs that drain into the **caval system** can be considered «**clean**» organs. they can filtrate or clean the blood/other components themselves without the help of the liver, and they may deal with toxic components singlehandedly.

Let`s test it!

Hepatic portal system («Dirty» organs)

Organs draining into hepatic portal system

Abdominal oesophagus + Stomach

Small intestine:

Duodenum, jejunum and ileum

Pancreas

Gallbladder

Colon:

Cecum + appendix, ascending, transverse, descending, sigmoid.

Spleen

Greater omentum & Lesser omentum

Anterior part of the abdominal wall and diaphragm

Rectum

GI tract

Natural gut flora (bacteria) + potential food poisoning,
absorption of drugs/medications etc.

Lymphatic organs, but is at high risk for damage after abdominal trauma + **high responsibility.**

Spleen also breaks down erythrocytes (bilirubin)

Higher risk for infections due to the anatomy

Venous plexus checkpoint
+ GI tract

Organs draining into hepatic portal system	Veins:
Abdominal oesophagus + Stomach	Right gastric vein and left gastric veins
<u>Small intestine:</u> Duodenum, jejunum and ileum	The small intestine is drained by the superior mesenteric vein. Duodenum is drained by superior pancreaticoduodenal veins --> portal vein
Pancreas	- Anterior superior and posterior pancreaticoduodenal veins --> sup. Mesenteric and splenic vein)
Gallbladder	Cystic vein
<u>Colon:</u> Cecum + appendix, ascending, transverse, descending, sigmoid.	Colic veins, sigmoidal veins, ileocolic vein (appendicular vein) --> Superior/inferior mesenteric vein --> Portal system)
Spleen	Splenic vein --> Portal vein
Greater omentum & Lesser omentum	- Greater omentum will be drained by gastro-omental veins (right and left) --> splenic vein/portal vein. - Lesser omentum will be drained by gastric veins (right and left) --> portal vein
Anterior part of the abdominal wall and diaphragm	Paraumbilical vein (drains into cystic vein) --> Portal vein
Rectum	The superior rectal vein drains into the inferior mesenteric vein

Healthy individual



*Superior mesenteric vein + splenic vein
→ portal vein*

Portal vein is formed at the L2 vertebral level.

Portosystemic blood flow

When the hepatic portal system does not work
(as this is usually the dominant blood flow)

The blood flow is guided by the pressure

- Lower pressure = blood wants to flow in that direction
- Higher pressure = harder for blood to flow in that direction. Blood flows/forces open another way with less pressure

Part 1

NB:

Red organs on the left are the organs mentioned above as the 4 major venous plexuses that drain into **both** caval and portal system!

(Porto-systemic checkpoints)

The red to the right are the «back-up veins kicking in when the portal system does not work (except for the checkpoints).

This is the one you want to learn!

Portosystemic anastomosis (when portal system does not work)	Veins: Red=caval Blue=portal
Abdominal oesophagus + Stomach	Right gastric vein and left gastric veins (The left gastric vein goes to both caval and portal --> Azygos vein).
<u>Small intestine:</u> Duodenum, jejunum and ileum	The small intestine is drained by the superior mesenteric vein. Duodenum is drained by superior pancreaticoduodenal veins and retroperitoneal veins
Pancreas	Anterior superior and posterior pancreaticoduodenal veins (--> sup. Mesenteric and splenic vein) Retroperitoneal veins of (head, neck and body)
Gallbladder	Cystic vein Paraumbilical vein (through cystic vein in reverse, then to epigastric veins) or Cholecystic veins into hepatic veins.
<u>Colon</u> Cecum + appendix, ascending, transverse, descending, sigmoid	Superior mesenteric vein Veins of Retzius

Part 2

Spleen	Splenic vein Retroperitoneal veins
Greater omentum & Lesser omentum	- Greater omentum will be drained by gastro-omental veins (right and left) --> splenic vein/portal vein. - Lesser omentum will be drained by gastric veins (right and left) --> portal vein Oesophageal veins + left gastric vein --> Azygos vein
Anterior part of the abdominal wall and diaphragm (Umbilical area)	Paraumbilical vein (drains into cystic vein) Epigastric veins: superior, inferior and superficial (drains into caval system)
Rectum	The superior rectal vein drains into the inferior mesenteric vein - Inferior rectal veins drain into internal iliac vein and the inferior rectal vein drain into the pudendal vein --> IVF

Caval system

«clean» organs

Organs draining into caval system	Veins
Kidneys + upper part of ureters	Right and left renal veins
Adrenal glands	<u>Right and left suprarenal veins</u> Right suprarenal vein --> Directly to inferior vena cava Left suprarenal vein --> Left renal vein --> inferior vena cava
Bladder + lower part of ureters	Vesical venous plexus --> vesical veins --> Internal iliac vein --> vertebral
Gonads (testes and ovaries) + lower part of ureters	<u>Testicular/ovarian veins (gonadal veins)</u> Right gonadal vein --> Directly to inferior vena cava Left gonadal vein --> Renal vein --> Inferior vena cava
Female reproductive organ	Drains into caval system. <u>Contributors:</u> Vaginal venous plexus, uterine vein, hypogastric venous plexus, internal pudendal vein
Prostate	Prostate venous plexus (PVP) --> Vesical venous plexus (to vesical veins) OR from PVP directly to internal vertebral plexus.

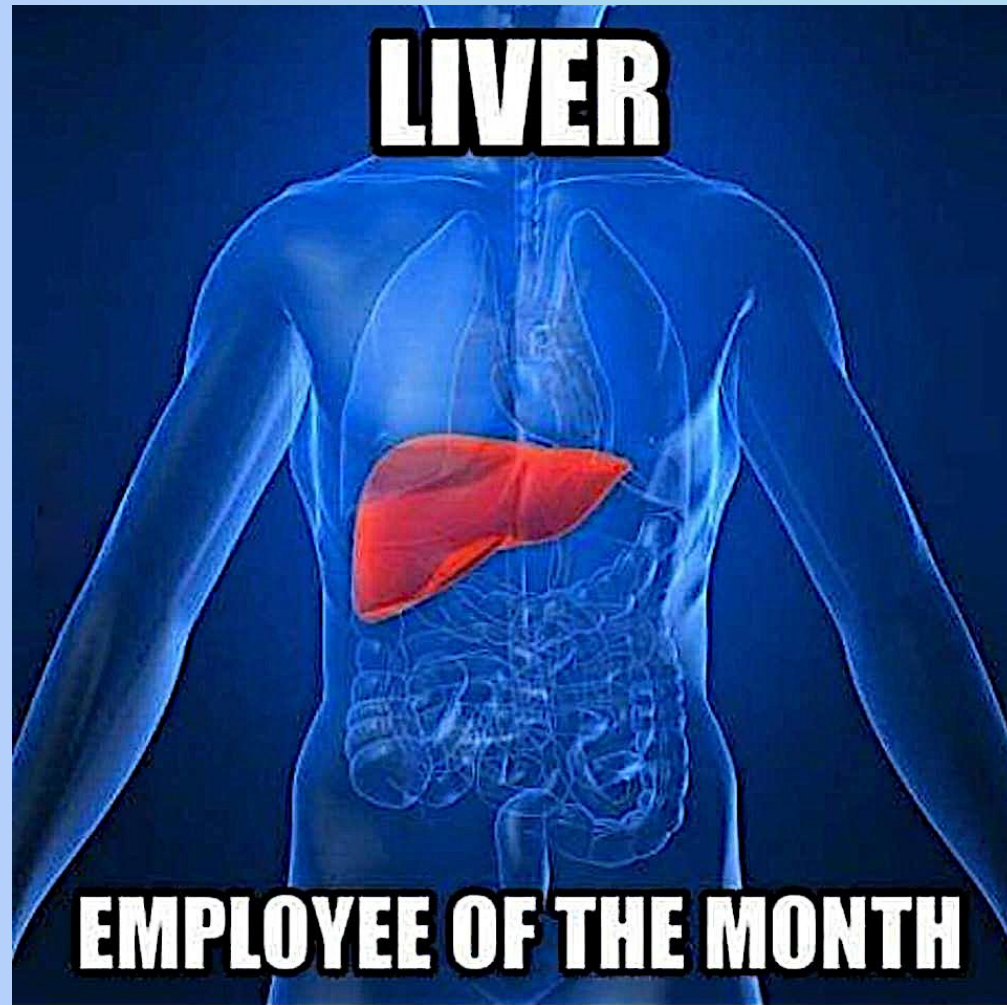
Kidneys filtrate. The rest are related to the kidneys

Must be clean/safe for fertilisation

Lactobacillus bacteria lowers pH + Must keep fetus safe

Must protect the sperm cells

Which organ is missing on this list, which will very obviously drain into the caval system?



Hepatic veins drain into the inferior vena cava and are therefore not part of the hepatic portal system!!

Organs draining into caval system

Kidneys + upper part of ureters

Adrenal glands

Bladder + lower part of ureters

Gonads (testes and ovaries)
+
lower part of ureters

Female reproductive organ

Prostate

Organs draining into hepatic portal system

Abdominal oesophagus + Stomach

Small intestine:

Duodenum, jejunum and ileum

Pancreas

Gallbladder

Colon:

Cecum + appendix, ascending, transverse, descending, sigmoid.

Spleen

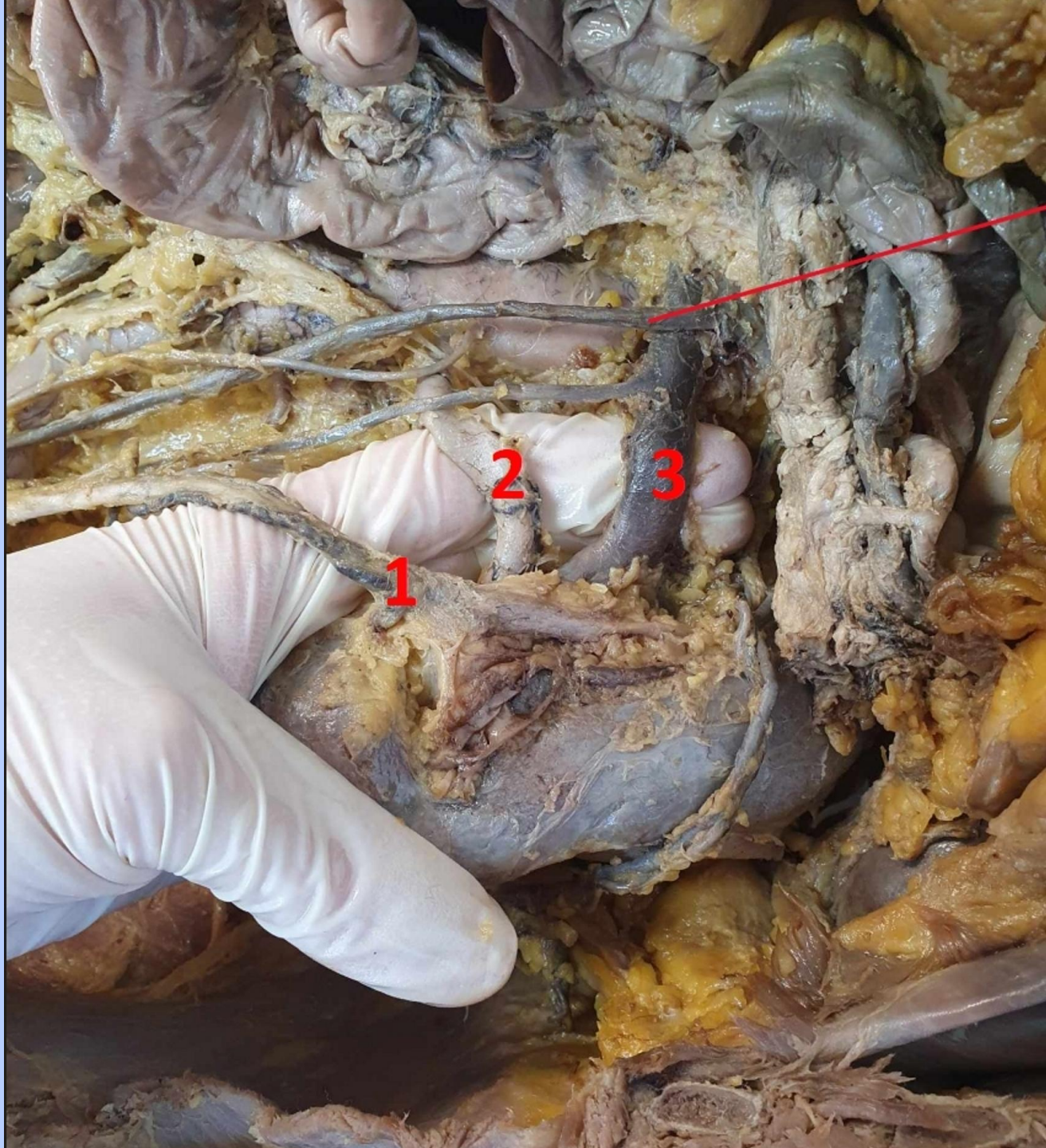
Greater omentum & Lesser omentum

Anterior part of the abdominal wall and diaphragm

Rectum

Mostly in the
pelvis →

GI organs +
high risk for
damage ←

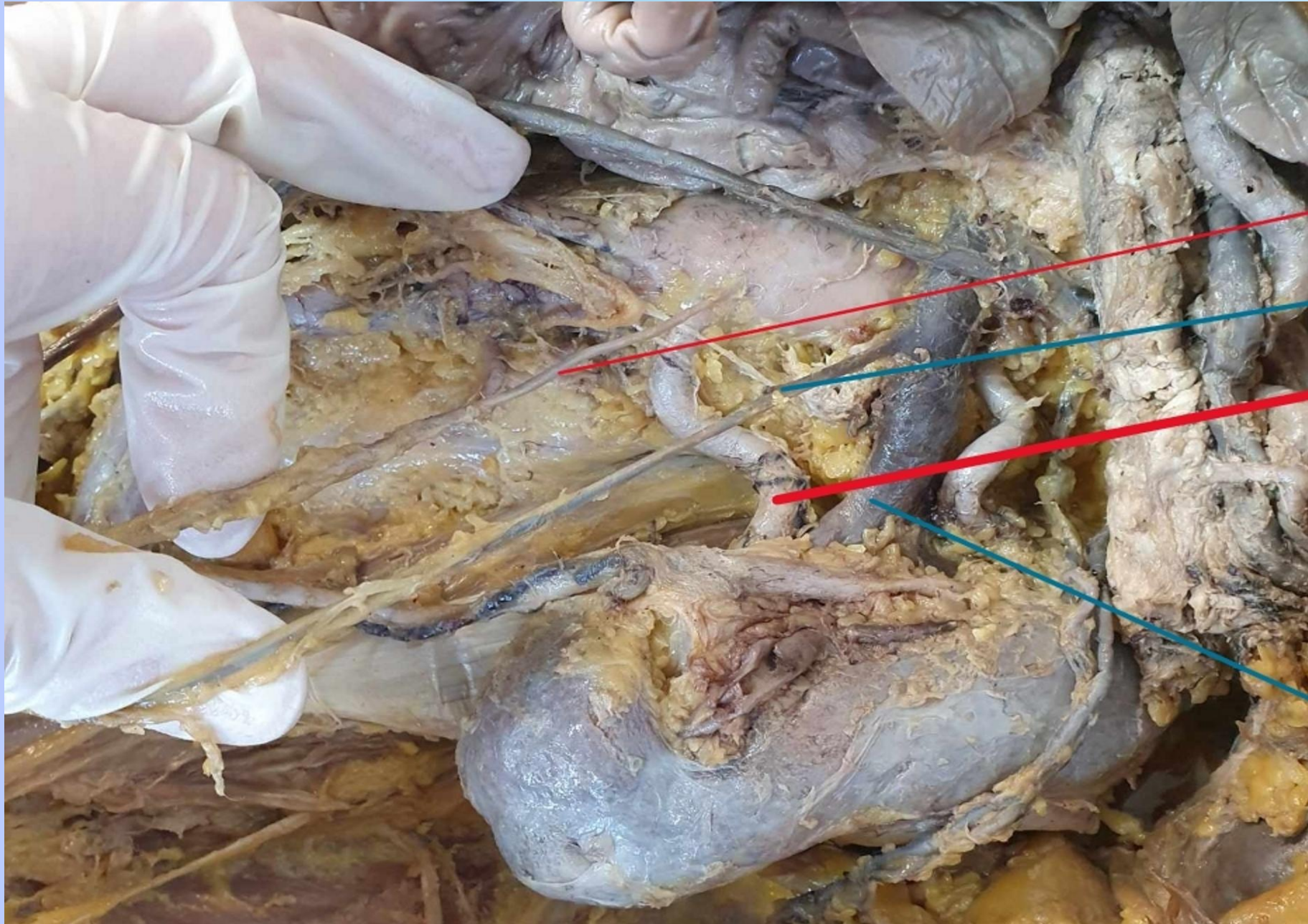


Inferior mesenteric vein

1. Ureter (left side)
2. Renal artery (left side)
3. Renal vein (left side)



Always lift up the structures!



Left side:

Testicular artery

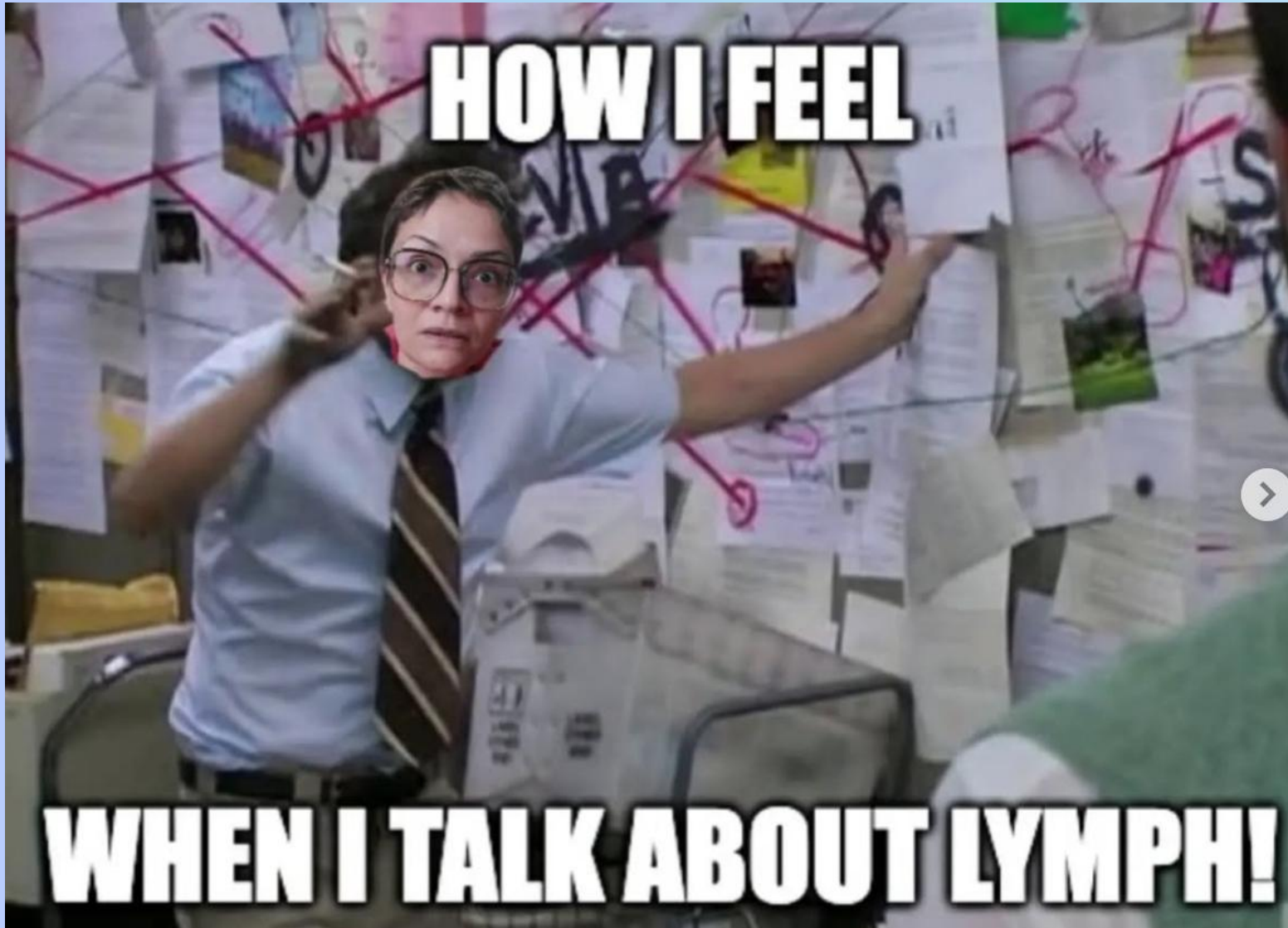
Testicular vein

Renal artery

Renal vein

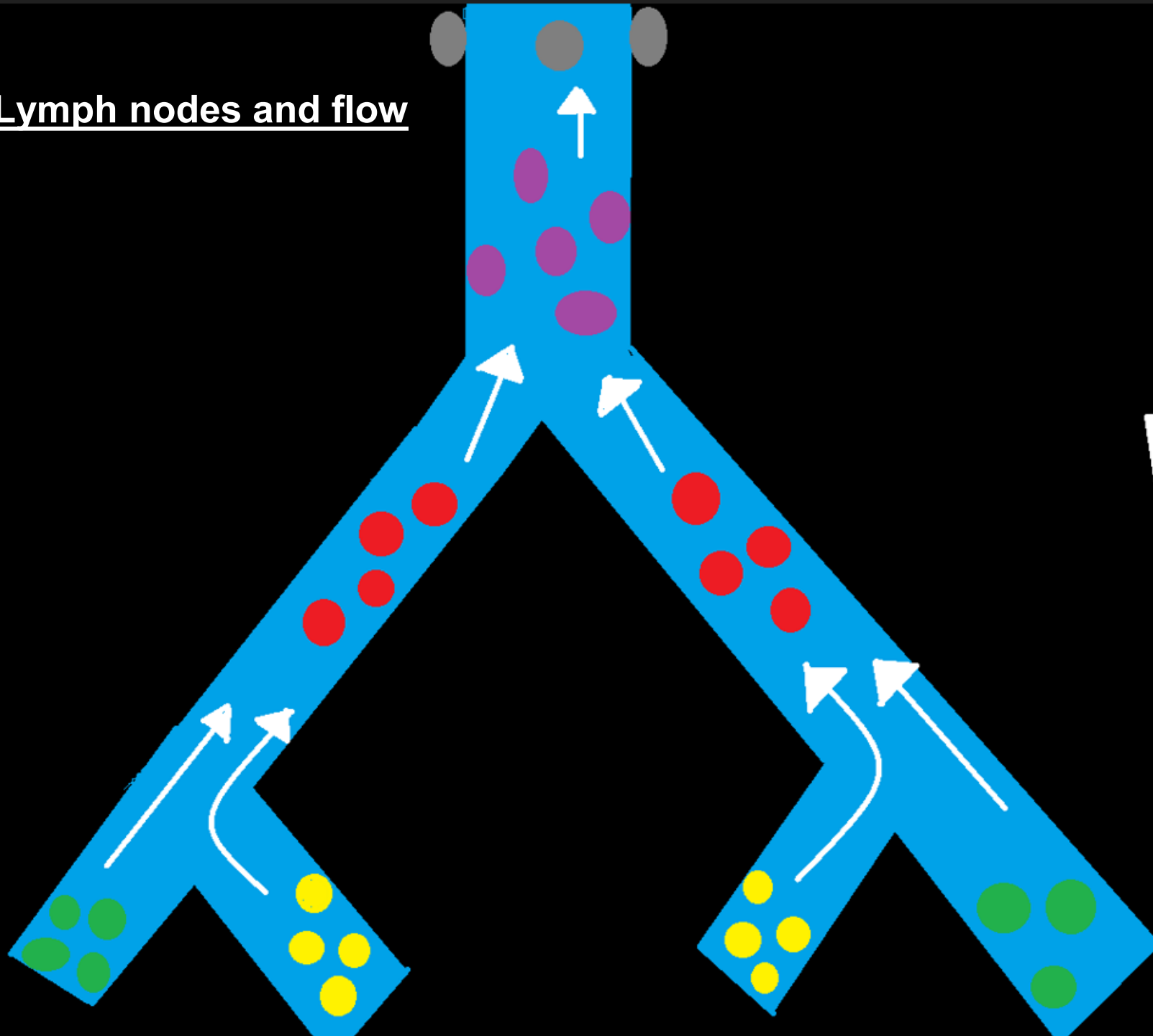


Lymphatic drainage of pelvis and abdomen



- ❖ Relevant lymph nodes **with flow**
- ❖ Drainage of female reproductive organs and perineum
- ❖ Testes and scrotum
- ❖ Stomach

Lymph nodes and flow



Internal iliac lymph nodes

External iliac lymph nodes

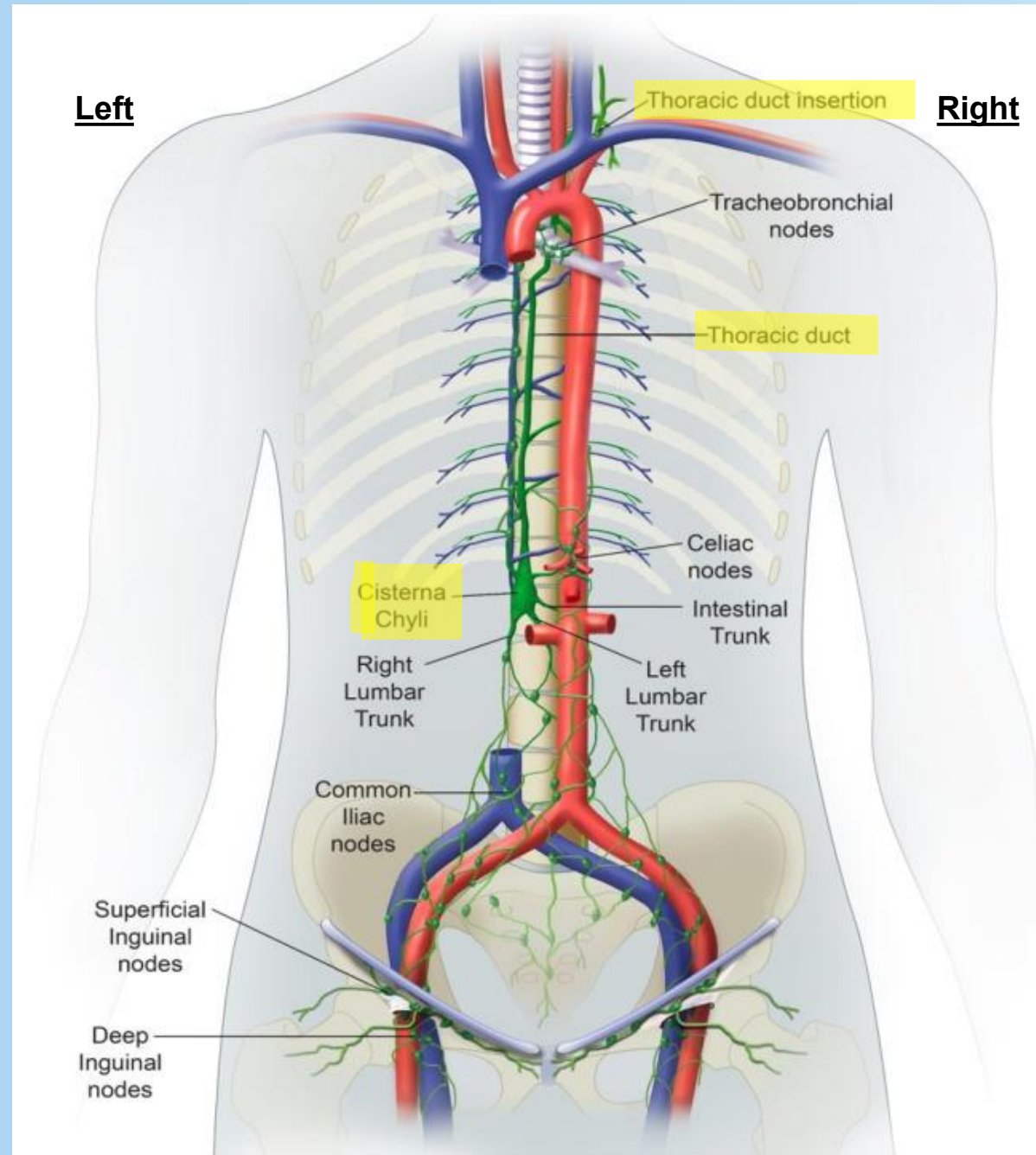
Common iliac lymph nodes

Lumbar lymph nodes

Para-aortic lymph nodes

Cisterna chyli

--> Thoracic duct



Lymphatic drainage of female reproduction organ

Anterior 2/3 of uterus (from fundus):

Internal iliac lymph nodes

Uterine horn:

Superficial inguinal lymph nodes

Supravaginal part of cervix (last 1/3):

Parametrial lymph nodes

(→ then drain into internal iliac lymph nodes)

Cervix:

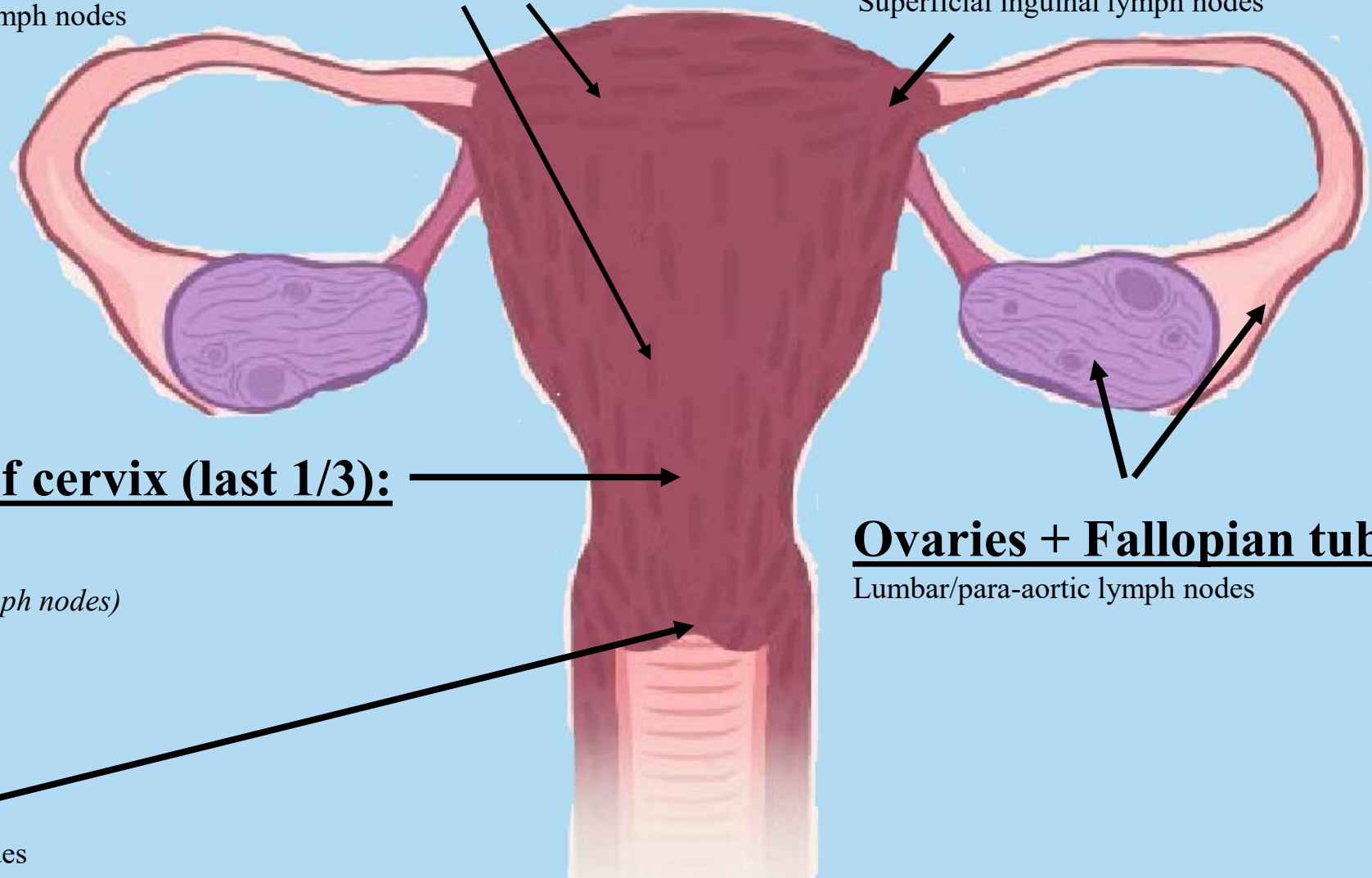
Internal iliac lymph nodes

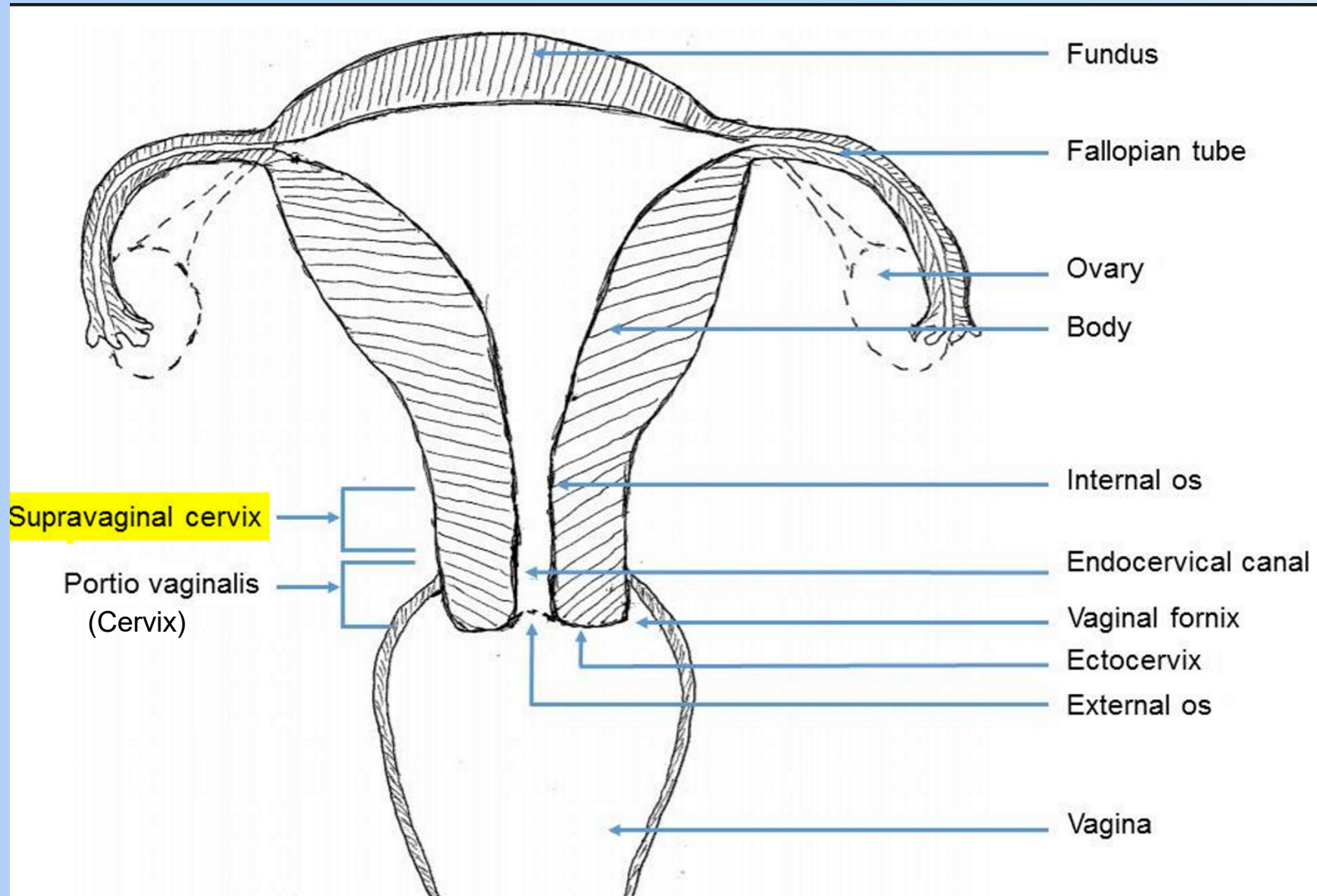
Ovaries + Fallopian tubes:

Lumbar/para-aortic lymph nodes

Perineum (vagina, labia, clitoris):

Superficial inguinal lymph nodes



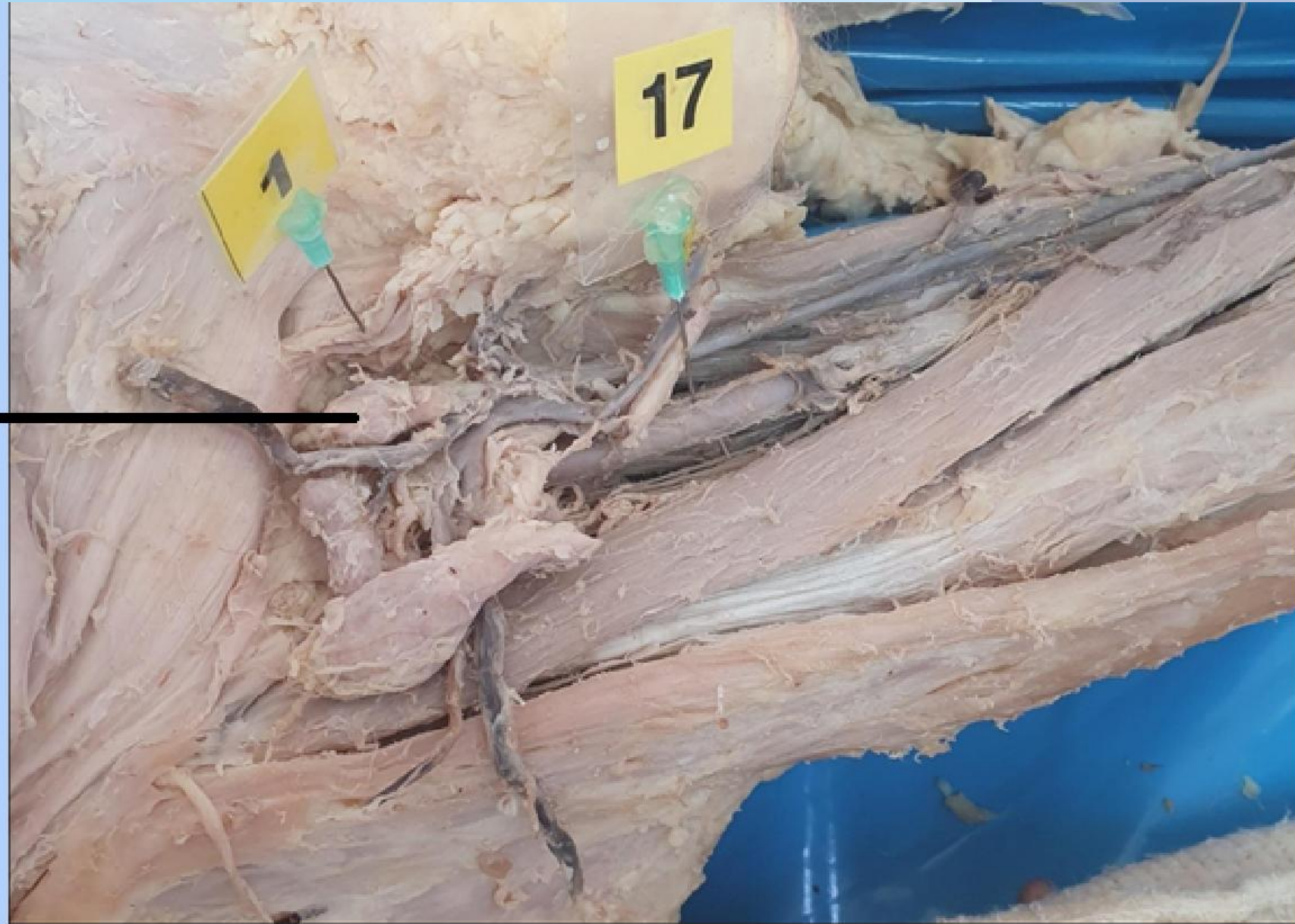


1: Round ligament of the uterus

Superficial
inguinal lymph
node

NB:

Round ligament of uterus leaves the inguinal canal through the superficial inguinal ring, just as the spermatic cord does in men. **This is why the round ligament of the uterus drain into the superficial inguinal lymph nodes**

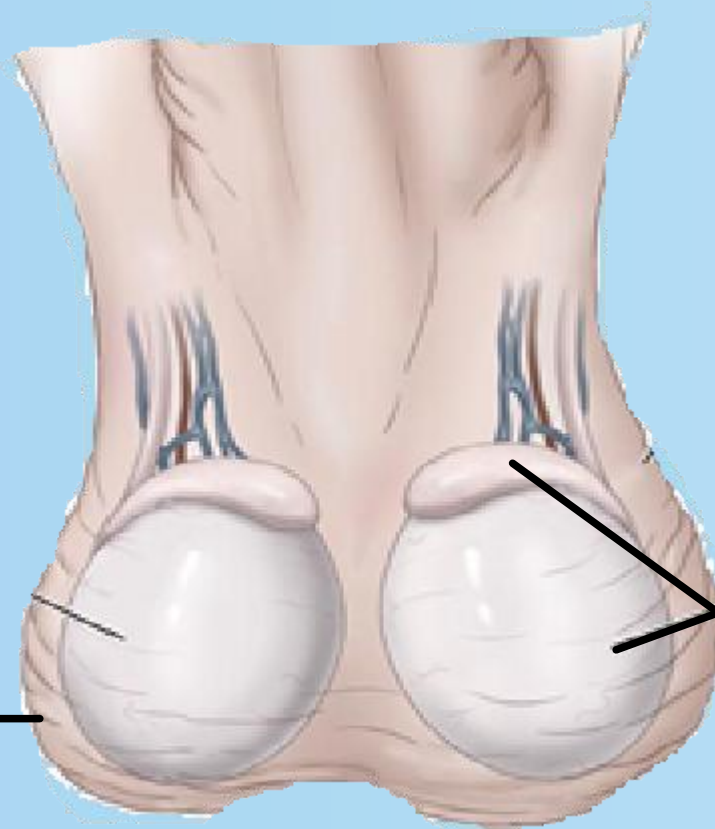


Lymphatic drainage of testes and scrotum

The scrotum is formed by the fusing of labia majora during the fetal stage

Testes develop in the abdomen and then descend to the pelvis

✓ *This explains the lymph and venous drainage.*



Scrotum:

Superficial inguinal lymph nodes
→
Deep inguinal lymph nodes

Testicle + epididymis:

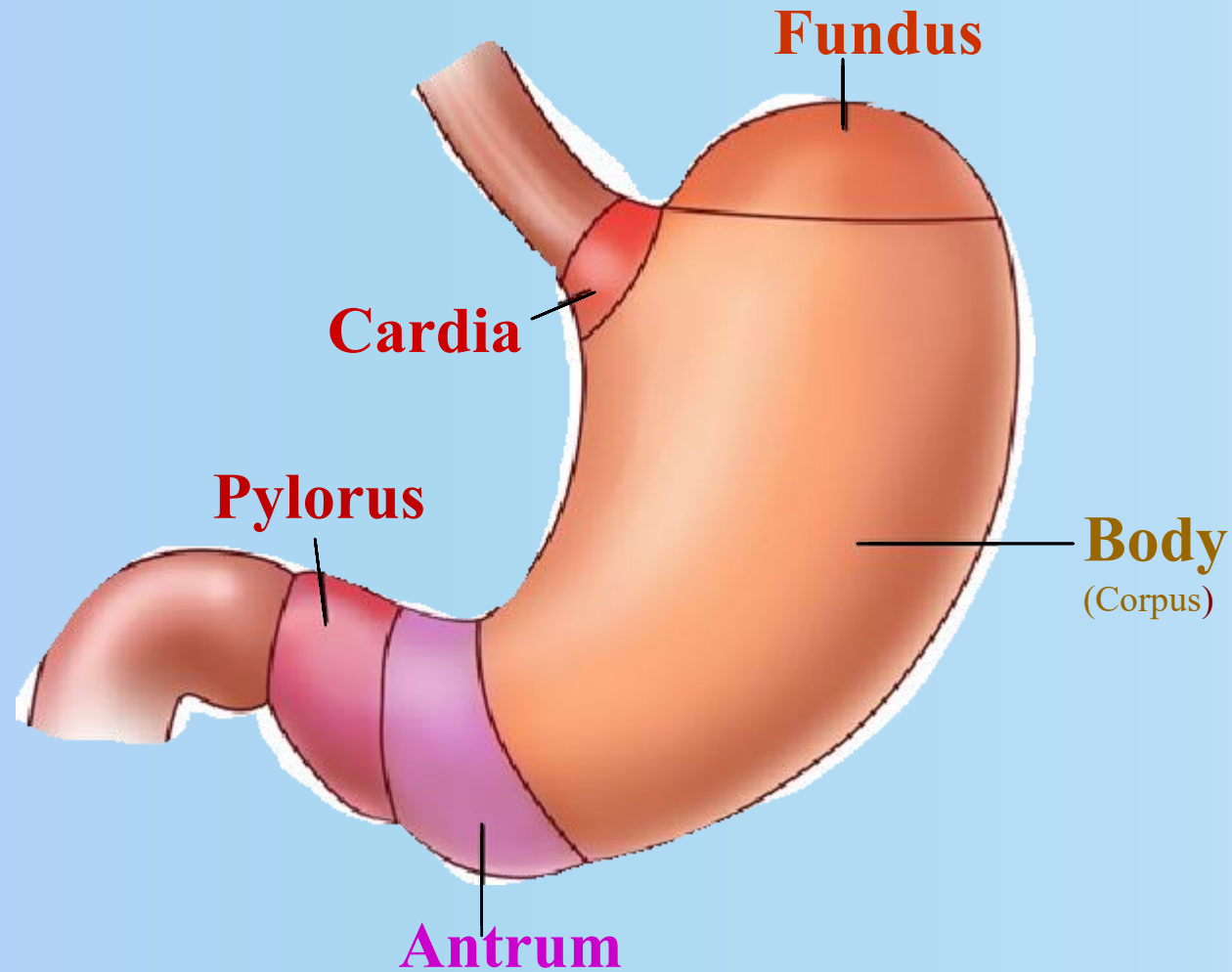
Lumbar lymph nodes
→
Para-aortic lymph nodes

Lymphatics of the stomach...

Warning:



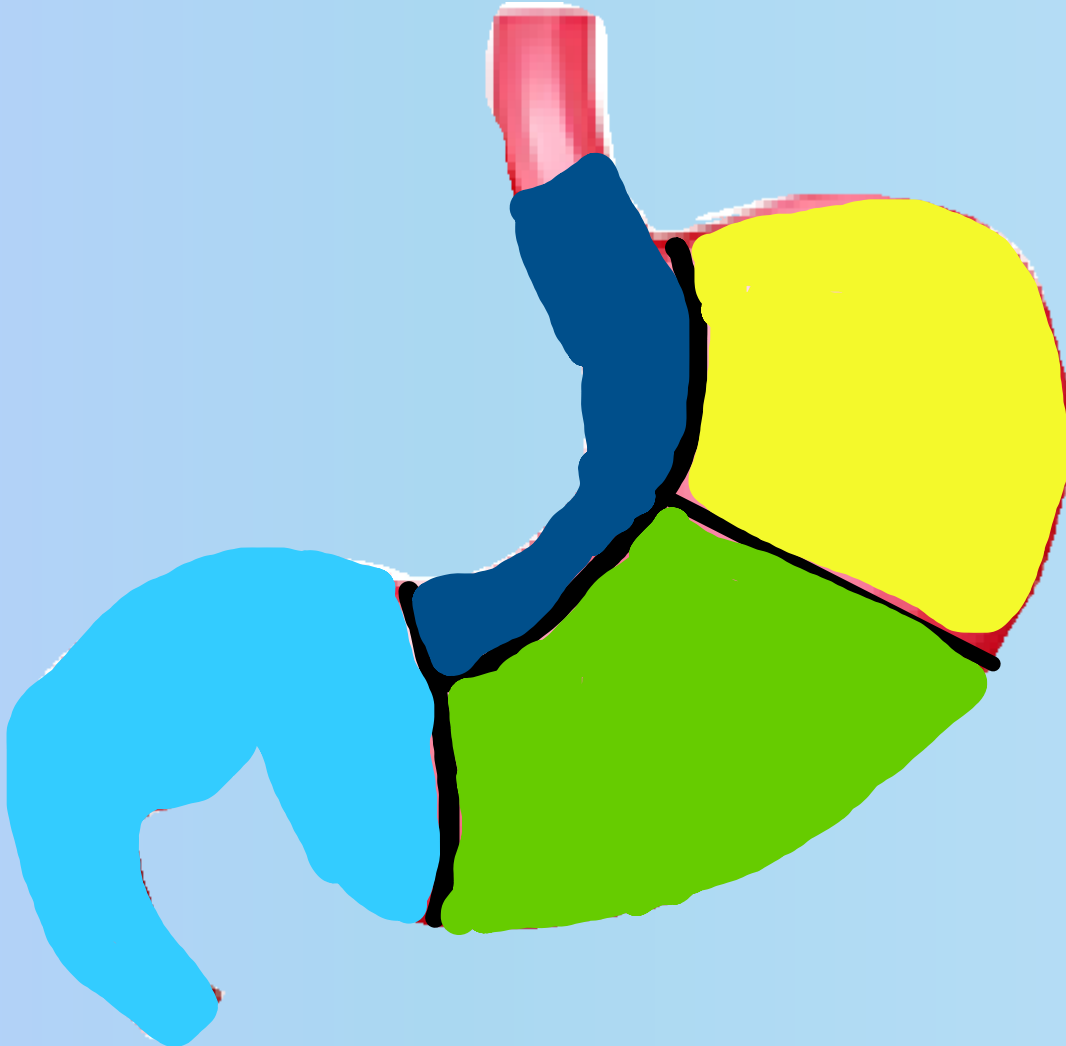
Reminder of the anatomy



NB:

The lymphatics of the stomach follow the **ARTERIES**, and **NOT** the veins!

The areas of drainage:



Remember this picture!

- The questions have to be SPECIFIC as the drainage areas do not match the original borders

1
= **Celiac lymph nodes**
(along the celiac trunk)

SHLN = Splenic hilum lymph nodes

2
= **Pancreaticosplenic lymph nodes**
(along the short gastric artery)

3
= **Left gastric lymph nodes**
(along the left gastroepiploic artery)

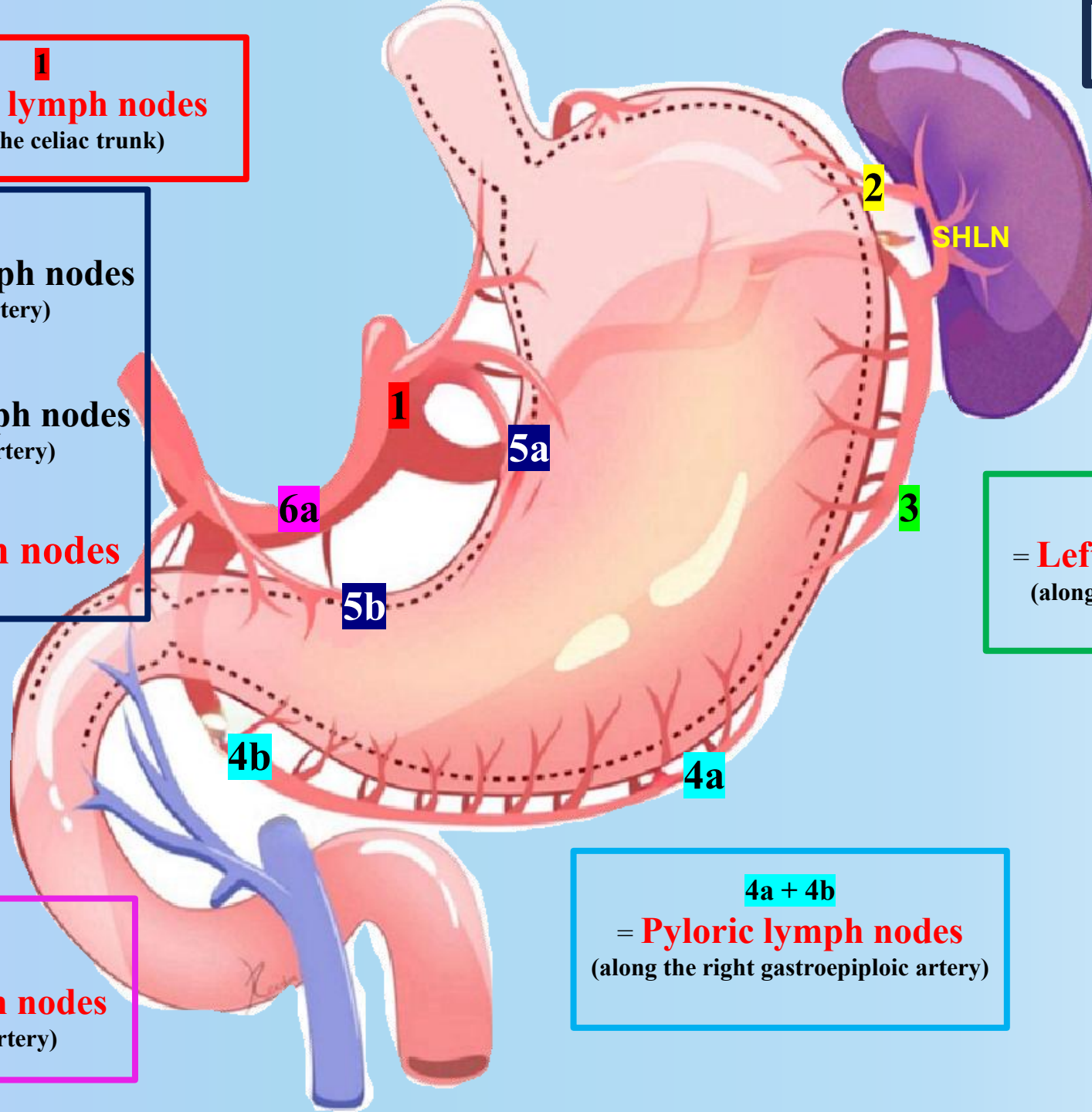
4a + 4b
= **Pyloric lymph nodes**
(along the right gastroepiploic artery)

6
= **Hepatic artery lymph nodes**
(along the common hepatic artery)

5a
= **Lesser curvature lymph nodes**
(along the LEFT gastric artery)

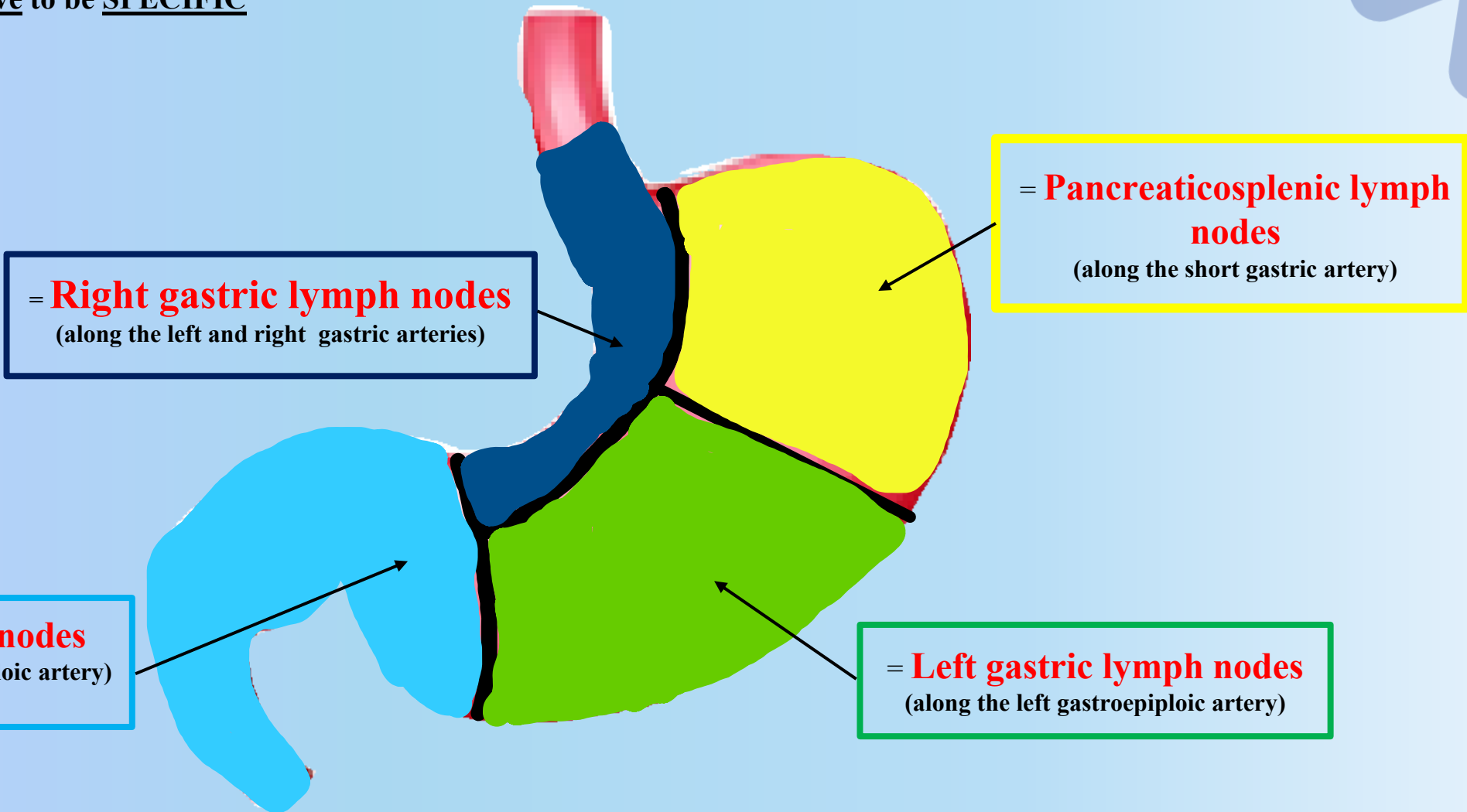
5b
= **Lesser curvature lymph nodes**
(along the RIGHT gastric artery)

5a + 5b
= **Right gastric lymph nodes**



Remember this picture!

- The questions have to be SPECIFIC

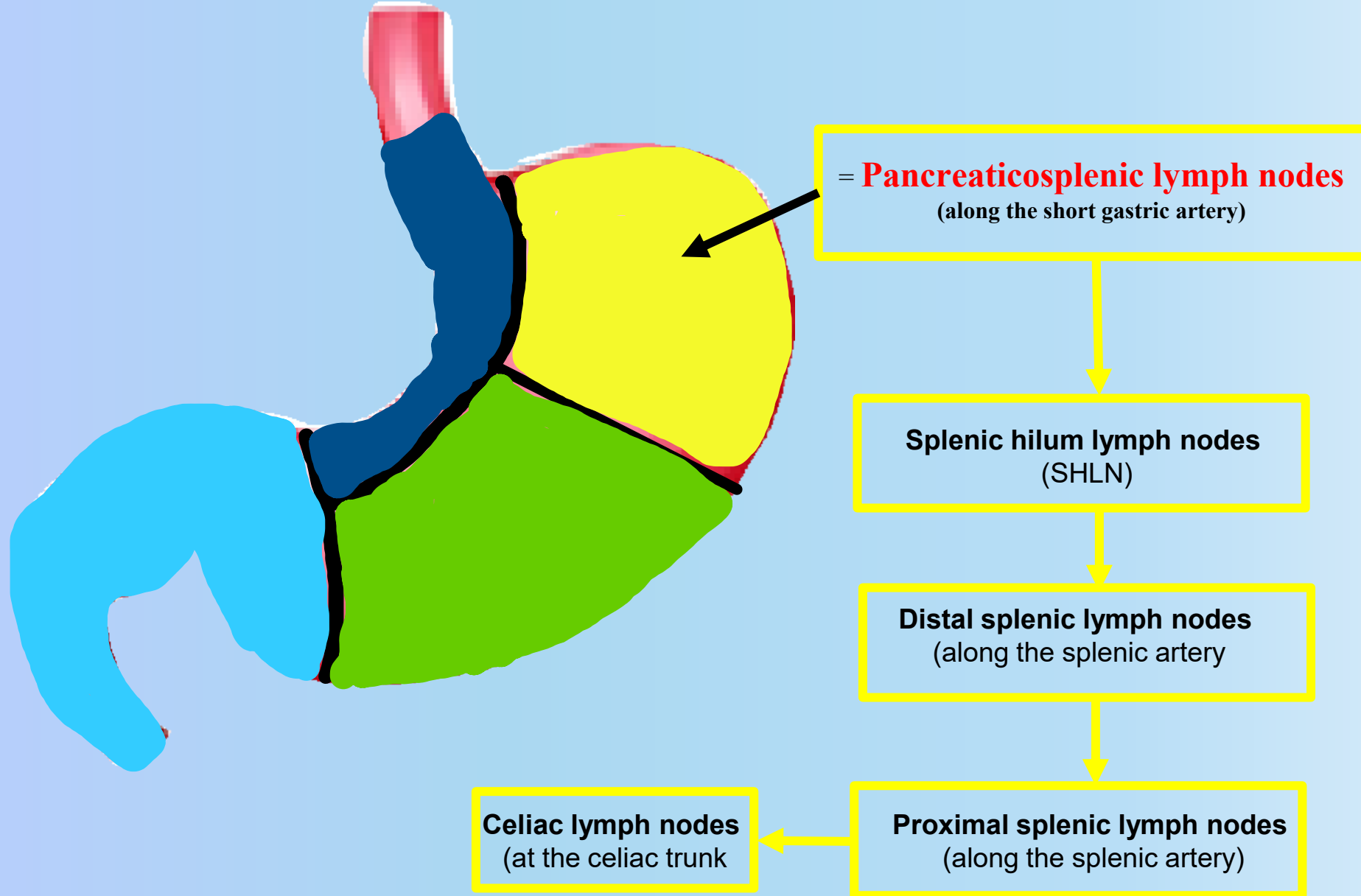


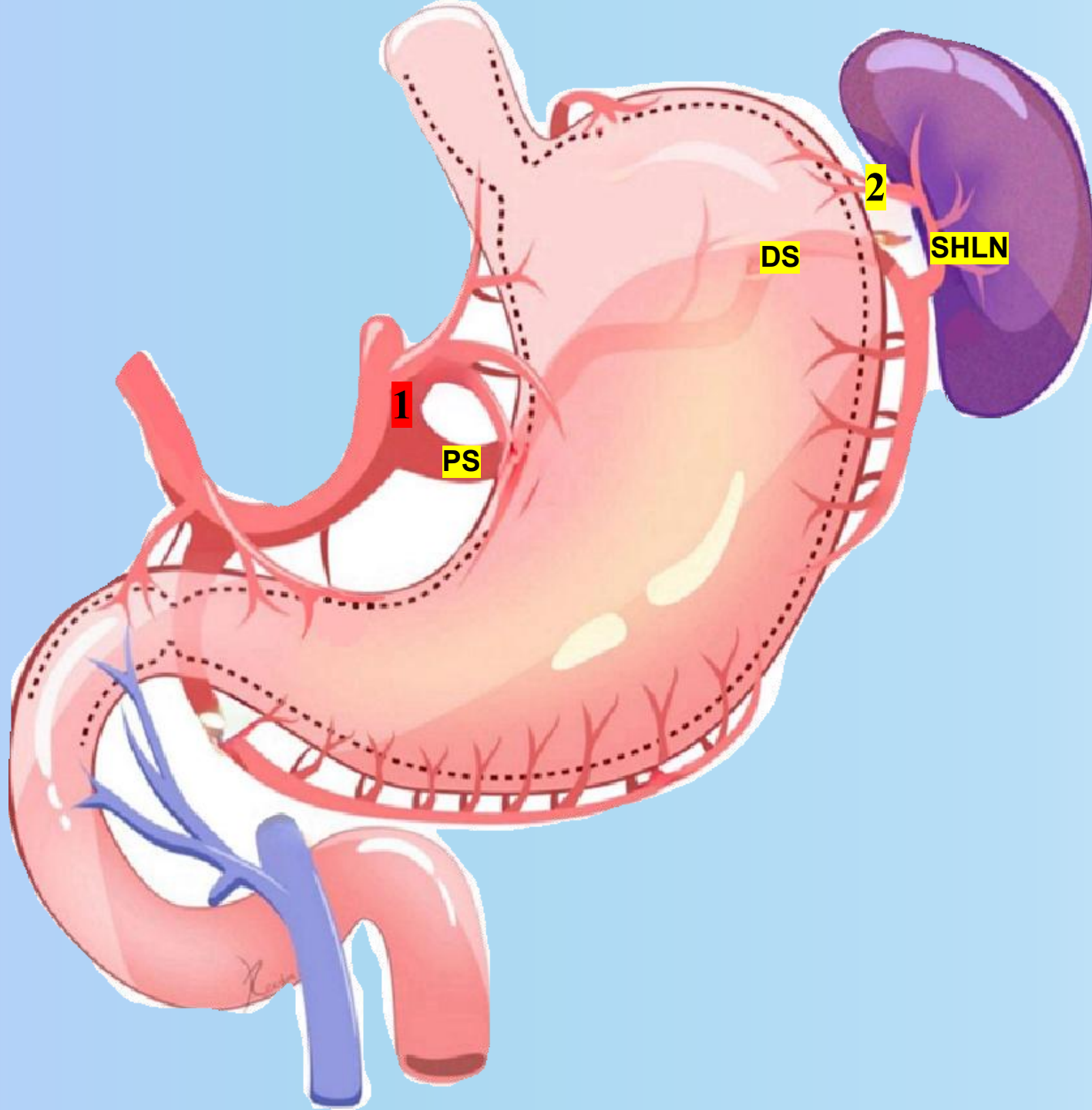
The main goal is to drain into, and get collected, at the **CELIAC LYMPH NODES** at the celiac trunk!

Which means:

Follow the arteries and the lymph nodes along them. *If you know the arteries, then you know the lymph nodes*

The example with flow:





2
= **Pancreaticosplenic lymph nodes**
(along the short gastric artery)

SHLN = Splenic hilum lymph nodes

DS = Distal splenic LN

PS = Proximal splenic LN

1
= **Celiac lymph nodes**
(along the celiac trunk)